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BEFORE THE BOARD OF PATENT APPEALS AND INTERFERENCES

Paper No. 27

Application Number: 08/902,809
Filing Date: July 30, 1997
Appellant(s): Schuegraf et al.

Robert E. Mates
For Appellant

EXAMINER'S ANSWER

This is in response to appellant's brief on appeal filed August 7, 2000.

(1) Real Party in Interest

A statement identifying the real party in interest is contained in the brief.

(2) Related Appeals and Interferences

A statement identifying the related appeals and interferences which will directly affect or be directly affected by or have a bearing on the decision in the pending appeal is contained in the brief.

(3) Status of Claims

The statement of the status of the claims contained in the brief is correct.

(4) Status of Amendments After Final

The appellant's statement of the status of amendments after final rejection contained in the brief is correct.

(5) Summary of Invention

The summary of invention contained in the brief is correct.

(6) Issues

The appellant's statement of the issues in the brief is substantially correct. The changes are as follows:

The rejection of claims 26-31, 36-41 and 44 under 35 U.S.C. 112, second paragraph is withdrawn.

Whether claims 23, 25-27, 29, 30, 36, 38, 42 and 44 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ho et al. and Keller et al. in view of McLevige.

Whether claims 24, 28, 31, 37, 39-41 and 43 are rejected under 35 U.S.C. 103(a) as being unpatentable over Ho et al., Keller et al. and McLevige, as applied above, and further in view of Gonzalez.

(7) Grouping of Claims

The rejection of claims 23-31 and 36-44 stand or fall together because appellant's brief does not include a statement that this grouping of claims does not stand or fall together and reasons in support thereof. See 37 CFR 1.192(c)(7).

(8) Claims Appealed

The copy of the appealed claims contained in the Appendix to the brief is correct.

(9) Prior Art of Record

The following is a listing of the prior art of record relied upon in the rejection of claims under appeal.

5,364,804	Ho et al.	11-1994
5,707,898	Keller et al.	01-1998
5,608,249	Gonzalez	03-1997
4,711,701	McLevige	12-1987

(10) Grounds of Rejection

The following ground(s) of rejection are applicable to the appealed claims:

Claims 23-31 and 36-44 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to

enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Regarding claims 23-25, there is no support in the specification for a spacer terminating at a boundary between a feature and an oxide layer, yet not being in contact with the oxide layer. If a spacer terminates at a boundary between a feature and an oxide layer, then the spacer must be in direct contact with the feature and the oxide layer. There is no support in the specification for a spacer being in direct contact with the feature and the oxide layer, and at the same time not being in contact with the oxide layer.

Regarding claims 25-31 and 38-44, there is no support in the specification for an oxide layer forming a boundary with a feature.

Regarding claims 26-31, 36-41 and 44, there is no support in the specification for a layer of gate oxide deposited under the gate such that enabling one skilled in the art to make and/or use the device.

Regarding claims 26-31 and 36-41, there is no support for a feature over the first layer of oxide and a feature protruding from the first layer of oxide in the specification.

Regarding a smile formed at the boundary between the feature and the oxide layer or the first layer of oxide in claims 25, 29-31 and 38, there is no support in the specification of any boundary between the feature and the first oxide layer.

Claims 26-31 and 36-41 and 44 are rejected under 35 U.S.C. 112, first paragraph, as containing subject matter which was not described in the specification in such a way as to reasonably convey to one skilled in the relevant art that the inventor(s), at the time the application was filed, had possession of the claimed invention. The specification does not describe a layer of gate oxide under the gate in such a way as to convey to one skilled in the art the function ability of the semiconductor device without a gate oxide.

Claims 23, 25-27, 29, 30, 36, 38, 42 and 44, insofar as in compliance with 35 U.S.C. 112, are rejected under 35 U.S.C. 103(a) as being unpatentable over Ho et al. and Keller et al. in view of McLevige.

Keller et al. teach in figure 2 substantially the entire claimed structure, including a first oxide layer (19, figure 1 and column 2, lines 65-66), a feature 20 being a gate electrode comprising polysilicon (column 2, line 67) and a dielectric 21 on the first oxide layer, the feature having a surface and being contiguous with the oxide layer at a boundary, a spacer 24 having a smile effect deposited only on the sidewalls of the feature and not on the first layer of oxide, terminating at a boundary between the feature and the oxide layer, and a second insulating

layer 26 comprising undoped silicon oxide (column 3, line 20-21) on the spacer, and a layer of oxide 25 (figure 1, column 3, line 4-5) deposited over the gate electrode.

Keller et al. do not teach a spacer comprising silicon nitride.

Ho et al. teach in figure 10 a first oxide layer 14, a feature 16 being a gate electrode comprising polysilicon and a dielectric 20 on the first oxide layer, the feature having a surface and being contiguous with the oxide layer at a boundary, a spacer 26 having a smile effect deposited on the sidewalls of the feature and terminating at a boundary between the feature and the oxide layer, a second insulating layer 28 comprising silicon nitride (column 3, line 52) on the spacer, and a layer of oxide 22 deposited over the gate electrode.

Ho et al. do not teach a spacer comprising silicon nitride only on the surface of the feature.

McLevige teaches in figure 3c a first layer of dielectric 38, a feature 142 over the first layer, a boundary between the feature 142 and the first layer 38, and a spacer 64 having a smile effect comprising silicon nitride (column 5, lines 18-20) only on the surface of a feature 142.

Although McLevige does not state that the statement "in the case that the silicon nitride is omitted, the silicon dioxide could be replaced by silicon nitride" (column 5, lines 18-20) refers to spacer 64 and layer 38, it is clear that McLevige refers to spacer 64 and layer 38. McLevige describes throughout the written specification only one layer comprising silicon nitride, namely, layer 38. McLevige further teaches that layers 62, 64 and 66 are formed during one deposition of a silicon dioxide (column 3, lines 6-9). Therefore, all three layers must be formed of the same material. There is no reference in McLevige's invention to other layers

comprising silicon nitride and silicon dioxide. Therefore, it is clear that the above statement means that layer 38 should be omitted, and layers 62, 64 and 66 are formed of silicon nitride. McLevige does not teach a first layer of oxide.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to form a device comprising a first layer of oxide, a feature over the first layer, and a spacer comprising silicon nitride only on the surface of a feature in McLevige, Ho et al. or Keller et al., in order to provide better protection for the device with an oxide layer underneath the feature and the harder to etch silicon nitride on the surface of the feature. Furthermore, it is well known in the art to form a spacer comprising silicon oxide or silicon nitride, since both materials are commonly used in the semiconductor industry as dielectric layers. The combination is motivated by the teaching of McLevige who points out that silicon oxide and silicon nitride are interchangeable materials, and silicon nitride can replace silicon oxide in the formation of spacers having a smile effect.

Regarding the claimed limitation of a second oxide spacer having a smile effect, Keller et al. teach in figure 2 that it is well known in the art to form a spacer having a smile effect not contacting a boundary between a feature and an oxide layer. Therefore, it would have been obvious to a person of ordinary skill in the art at the time the invention was made to use a second oxide spacer having a smile, as claimed.

Regarding the processing limitations recited in claim 25 ("being formed by a polycide reoxidation"), these would not carry patentable weight in this claim drawn to a structure, because distinct structure is not necessarily produced. In re Thorpe, 227 USPQ 964 (Fed. Cir. 1985).

Claims 24, 28, 31, 37, 39-41 and 43, insofar as in compliance with 35 U.S.C. 112, are rejected under 35 U.S.C. 103(a) as being unpatentable over Ho et al., Keller et al. and McLevige, as applied to claims 23, 26, 30, 36, 39 and 42, above, and further in view of Gonzalez.

Ho et al., Keller et al. and McLevige teach substantially the entire claimed structure, as applied above, except a gate comprising a tungsten silicide layer interposed between the polysilicon and the dielectric layers. Gonzalez teach in figure 2 tungsten silicide layer 22 (column 4, line 63) interposed between the polysilicon 20 and the dielectric 24 layers.

It would have been obvious to a person of ordinary skill in the art at the time the invention was made to deposit tungsten silicide layer interposed between the polysilicon and the dielectric layers in the above device, because it is known in the art to use tungsten silicide layer on a polysilicon layer in order to provide better contact and less resistance contact to the gate.

(11) Response to Argument

Appellants argue in pages 6-12 that active area 215 is an oxide layer and concludes that for various reasons it is correct to call an oxide layer an active area (page 11, lines 16-17) It is incorrect to call an oxide layer an active area. An oxide layer is a dielectric or insulating layer, whose purpose is to prevent movement of electrons and to provide insulation between elements. An active area, on the other hand, is a conductive area in which electrons move freely, and its purpose is to provide conductivity between two elements. In fact, 'conductivity' is the opposite terminology of 'insulation'. Therefore, it is incorrect to call an insulating layer a conductive layer.

More specifically, appellants argue on pages 6 and 7 that by examining figure 1 and the formation of spacers 210, an artisan would conclude from figure 2B that active area 215 is an oxide layer. The specification define area 215 as an active area, and not as an insulating layer. Figure 2B depicts layer 215 as being a separate layer from the field oxide layer. This distinction supports the description of layer 215 being an active area. If layer 215 is an oxide layer, there would be no boundaries between the two layers, and there would not be any need to form an oxide layer (221, figure 2D) on top of an oxide layer. Furthermore, the additional thickness of layer 215 under feature 205 is not consistent with the conventional structure of a gate oxide layer. Therefore, an artisan examining figure 2B and being taught that layer 215 is

a conductive layer (active area) would not come to the conclusion that layer 215 is an insulating layer. An artisan may hypothesize that the device of figure 2B is a MESFET transistor, in which the conductive gate is formed over the active area of the device.

Appellants further argue on page 7, lines 9-11, that reoxidation layer 220 implies an original layer of oxide, area 215. The specification recites "The oxidation process forms smile 225, and active area 215 and selective spacers are reoxidized 220." (column 5, lines 5-6). This sentence does not imply that active area 215 is an oxide layer. The specification clearly states that the original oxidation is the process which forms smile 225, and not active area 215.

Appellants argue on page 7 that since original claims 9 and 11 recite forming an insulating layer on the substrate and a conductive layer over the insulating layer, an artisan would conclude that the present claimed structure is a MOS transistor and the active area 215 is an oxide layer. The specification, the figures and present claimed structure describe a conductive feature formed on top of active area 215. A device comprising a conductive feature on top of an active area is a natural description of a MESFET transistor in which the conductive gate is formed over the active area of the device. Method claims 9 and 11, on the other hand, recite a different invention (restriction/election, paper 5). Even if, arguendo, an artisan would hypothesize that the invention directed to claims 9 and 11 recites a MOS transistor, it does not mean that the claimed invention is a MOS transistor. The claimed

structure is described as a MESFET transistor and not a MOS transistor. An artisan can not guess the construction and usage of a claimed invention. Appellants must describe the subject matter in the specification in such a way as to enable one skilled in the art to which it pertains, or with which it is most nearly connected, to make and/or use the invention.

Appellants argue on page 8 that the examiner understood that active area 215 is an oxide layer, and therefore an artisan would also understand that active area 215 is an oxide layer. The examiner did not understand that active area 215 is an oxide layer. Appellants did not describe the subject matter in the specification in such a way as to enable one skilled in the art to which it pertains. The specification recites a device comprising a conductive feature on an active area. On one hand, the device is not categorized as a MESFET transistor (which operates without a gate oxide), but on the other hand the device can not operate as a MOS transistor without an oxide layer. The examiner, therefore, requested clarification as to the structure of the new invention and discovery. Such request is by no means an indication that the examiner understood that active area 215 is an oxide layer.

Appellants argue on pages 8-11 that active area can mean everything in the semiconductor device between areas of field oxide, and thus active area 215 can mean an oxide layer. It is clear from the specification that active area 215 is not everything in the semiconductor device between areas of field oxide. Active area 215 does not comprise feature 205, spacers 210, 220

and reoxidized layer 220. In fact, active area 215 has distinct boundaries and is a completely separate element from feature 205, spacers 210, 220 and reoxidized layer 220. Therefore, active area 215 does not mean the area between the field oxides, as argued by Appellants.

To conclude, an oxide layer is not an active area, and in view of devices such as MESFET and MOS transistors, an artisan would not have the clear understanding that active area 215 is an oxide layer.

Moreover, the structural limitations of a spacer terminating at a boundary between a feature and an oxide layer, and not being in contact with the oxide layer, as recited in claim 23, is physically impossible. If element A terminates at a boundary between two other elements, then element A must be in direct contact with the other two elements. Therefore, it is impossible for element A to touch the other two elements and not to be in contact with one of them, at the same time.

Appellants argue on pages 13-15 that Keller et al. and Ho et al. do not teach a spacer comprising silicon nitride. One cannot show nonobviousness by attacking references individually where the rejections are based on combinations of references. See *In re Keller*, 642 F.2d 413, 208 USPQ 871 (CCPA 1981); *In re Merck & Co.*, 800 F.2d 1091, 231 USPQ 375 (Fed. Cir. 1986). Keller et al. and Ho et al. teach substantially the entire claimed

structure, except a spacer comprising silicon nitride. McLevige teaches a spacer comprising silicon nitride.

Appellants argue on pages 16-17 that McLevige does not state that the statement "in the case that the silicon nitride is omitted, the silicon dioxide could be replaced by silicon nitride" (column 5, lines 18-20) refers to spacer 64 and layer 38. McLevige describes throughout the written specification only one layer comprising silicon nitride, namely, layer 38. McLevige further teaches that layers 62, 64 and 66 are formed during one deposition of a silicon dioxide (column 3, lines 6-9). Therefore, all three layers must be formed of the same material. There is no reference in McLevige's invention to other layers comprising silicon nitride and silicon dioxide. Therefore, it is clear that the above statement means that layer 38 should be omitted, and layers 62, 64 and 66 are formed of silicon nitride.

Appellants argue on page that prior art teaches away from the combination. However, Keller et al. and Ho et al. teach substantially the entire claimed structure, except a spacer comprising silicon nitride. McLevige teaches a spacer comprising silicon nitride. The combination is motivated by the teaching of McLevige who points out that silicon nitride can replace silicon oxide in the formation of spacers having a smile effect since both dielectric are interchangeable.

Appellants argue on pages 17 and 18 that Keller et al. do not teach a spacer not contacting the boundary between a feature and an oxide layer, because the spacers of Keller et al. are themselves oxide. It is not clear to the examiner why a spacer must contact the boundary between a feature and an oxide layer if the spacer comprises oxide.

Appellants argue on page 18 that the examiner's conclusion of obviousness is based upon improper hindsight reasoning. It must be recognized that any judgment on obviousness is in a sense necessarily a reconstruction based upon hindsight reasoning. But so long as it takes into account only knowledge which was within the level of ordinary skill at the time the claimed invention was made, and does not include knowledge gleaned only from the applicant's disclosure, such a reconstruction is proper. See *In re McLaughlin*, 443 F.2d 1392, 170 USPQ 209 (CCPA 1971). In this case, McLevige specifically teaches that a spacer having a smile effect and comprising silicon nitride can replace a spacer having a smile effect and comprising silicon oxide. Moreover, silicon oxide and silicon nitride are well known insulating materials, conventionally used to insulate gate electrodes and features. It is well within the skills of an artisan to use any of these two conventional materials to form insulating layers such as spacers, gate dielectric and passivation layers.

For the above reasons, it is believed that the rejections should be sustained.

Respectfully submitted,

Ori Nadav
September 22, 2000

Minh Loan Tran
Primary Examiner